Movements and habitat use of Yellowstone River native fishes and reptiles and nesting distributions of native birds

Matthew Jaeger, Ken Frazer, Mark Nelson, Mike Vaughn, Brad Schmitz, Jim Darling
Montana Department of Fish, Wildlife and Parks
P.O. Box 1630
Miles City, MT 59330

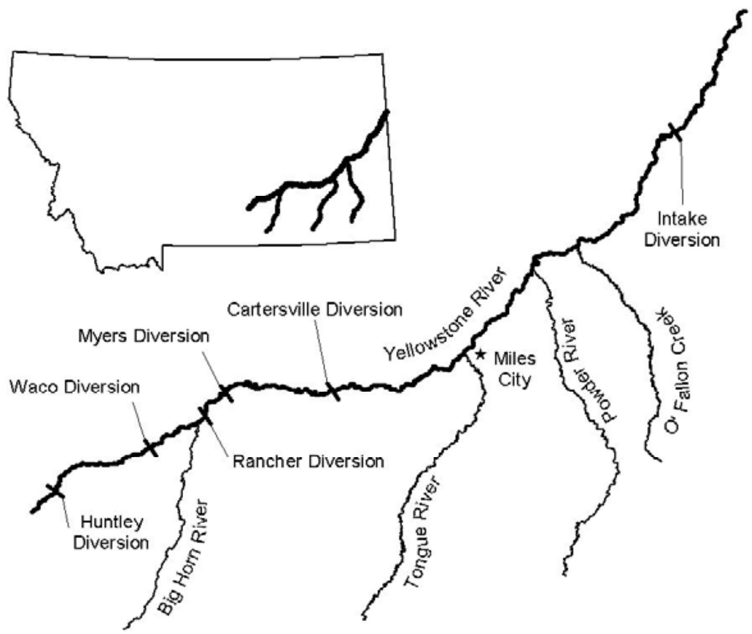
Summary

Objectives for the first season of the Yellowstone River corridor native species project were successfully achieved; most transmitters were implanted (n=195) and tracking began. Objectives for season two include implanting remaining burbot transmitters (45) during the spring post-spawning period, tracking telemetered fish and turtles, and quantifying habitat characteristics. Additionally, the Region 5 crew will commence work upstream of the confluence with the Big Horn River.

Need

The Yellowstone River is the longest free-flowing river in the contiguous United States and represents some of the most pristine large-river habitat in North America. The fish assemblage comprises 49 species from 15 families, including eight state-listed Species of Special Concern and one federally listed endangered species (White and Bramblett 1993). The riparian corridor also supports a diverse wildlife assemblage, including spiny soft-shell turtles and federally threatened bird species such as interior least tern, bald eagle, and possibly piping plovers. Accordingly, this faunally rich ecosystem has considerable ecological value and supports a culturally important recreational fishery resulting in designation as a tier I Aquatic Conservation Focus Area in the Comprehensive Fish and Wildlife Conservation Strategy (CFWCS). However, limited life history and behavioral information currently exists for most native species in this assemblage, thereby restricting management options and effectiveness. Therefore, the objective of this study is to increase the knowledge base for ecologically and culturally important native Yellowstone River fish and wildlife to guide the formulation of management strategies that will benefit this unique ecosystem. Specific emphasis will be placed on spiny soft-shell turtles, interior least terns, bald eagles, blue sucker, burbot, channel catfish, and shovelnose sturgeon, because of a combination of scarcity or recreational and cultural importance and a limited knowledge base. Because of the length of the Yellowstone River corridor (Figure 1) and highly migratory nature of the target species, this study will be a coordinated multi-jurisdictional effort between the Region 5 and 7 Fisheries and Wildlife Divisions of Montana Fish, Wildlife and Parks.

Figure 1. The lower Yellowstone River, its major tributaries, and diversion dams.



Blue suckers are considered a Species of Special Concern by the American Fisheries Society and State of Montana (Carlson 2003), a tier I species of Greatest Conservation Need by the CFWCS, and a category 2 species (taxa for which information indicated that proposing to list as endangered or threatened was possibly appropriate, but for which sufficient data on biological vulnerability and threat were not currently available to support proposed rules) by the U.S. Fish and Wildlife Service because of range-wide habitat alteration and fragmentation. Primary threats to blue sucker in Montana include habitat fragmentation by high- and low-head dams and dewatering of critical tributary spawning habitats (Gardner 1998). Blue sucker may be especially vulnerable to migratory barriers and loss of spawning and rearing habitats because of their migratory nature, high spawning habitat specificity, and perceived poor reproductive success and recruitment (Gardner 1998). However, information regarding spawning and rearing habitats of blue sucker is limited; spawning may occur primarily in tributaries although rearing areas are unknown (Gardner 1998). Accordingly, identification of spawning and rearing areas was established as the primary research priority in Montana (Gardner 1998).

Loss and fragmentation of blue sucker habitat may be especially prevalent in the Yellowstone River, where diversion dams potentially restrict movements and chronic dewatering of tributaries may eliminate scarce spawning and rearing habitats, but information gaps regarding basic ecology prevent assessment of the extent of habitat disruption. Heretofore, management and research efforts have been limited to routine monitoring. Although exploratory movement studies have occurred in the Missouri River (e.g. Braaten and Fuller 2004), seasonally important habitats of blue sucker remain poorly understood. Furthermore, no movement studies have focused on the Yellowstone River blue sucker population and, consequently, the role of diversion dams in preventing access to important habitat types is equivocal. Spawning in the Yellowstone drainage is thought to occur primarily in the Tongue River, although this area may have been lost as a result of dewatering during spawning periods. Recent studies indicate adult blue sucker may now inhabit the Yellowstone River only during non-spawning periods (Braaten and Fuller 2004), and spawning and rearing habitats may have been eliminated.

Burbot (a tier I species of Greatest Conservation Need) and channel catfish support a culturally valuable recreational fishery on the Yellowstone River, but information gaps regarding seasonal movements and important habitats limit effective management of these species (Montana Fish, Wildlife and Parks 1997; Jones-Wuellner and Guy 2004). Although channel catfish are present throughout the Yellowstone River drainage, the population above Cartersville Diversion appears to be composed almost exclusively of adult fish. Intensification of this trend beyond the four upstream diversion dams suggests that they are size-selective barriers; however, routine sampling in these reaches indicates that channel catfish are only seasonally present, suggesting that suitable spawning and rearing habitat may not exist, and long distance migrations occur. Even greater information gaps exist for burbot; highly variable results of drainage-wide inter- and intra-annual sampling efforts (Jones-Wuellner and Guy 2004) potentially signify dynamic seasonal and annual migration patterns, although no information regarding movement patterns and habitat use in the Yellowstone River exists. Local bait dealers have expressed concern about increased harvest of large catfish and burbot, yet basic information regarding population ecology that would justify adjustment of fishing regulations is lacking. The likelihood of long distance migrations and discrete spawning aggregations of burbot and channel catfish in the Yellowstone River necessitates a better understanding of seasonal movements and habitat use, including the potential fragmentary effects of diversion dams, for effective management to occur.

Shovelnose sturgeon are abundant in reaches of the Yellowstone River downstream of Cartersville Diversion but are functionally absent upstream of this dam. Previous sampling efforts, angler photographs, and other anecdotal evidence suggests this species was historically present and abundant well upstream of Cartersville Diversion but has likely been extirpated by the cumulative effects of flow alteration of the Big Horn River and installation of barriers (low head diversion dams) on the Yellowstone River. Similar anthropogenically influenced declines in shovelnose sturgeon distributions and abundances have occurred throughout their range in other large-river ecosystems; however, the relatively pristine reaches of the lower Yellowstone River likely support the highest densities of shovelnose sturgeon range-wide making it an ideal location to characterize the ecology and habitat requirements of this species.

Spiny softshell turtles, a tier I species of Greatest Conservation and Inventory Need, occur in the study area, yet very little is known about their distribution, movements, or habitat use. Describing this life history information will benefit managers not only in the Yellowstone corridor, but also in the adjacent Missouri River as flow recommendations are developed.

Description of seasonal movement patterns and habitat use of blue sucker, channel catfish, burbot, shovelnose sturgeon, and spiny soft-shell turtles in the Yellowstone River will elucidate the seasonable suitability of segments of this drainage as well as the effect of diversion dams. This information will contribute to the limited knowledge base we have of these species and result in more effective management and conservation efforts. Furthermore, data collected in this study comprise a critical and essential component of ongoing research efforts for pallid sturgeon, a federally Endangered tier I species of Greatest Conservation Need, and sauger, a tier I species of Greatest Conservation Need.

Bald eagles, least terns, and piping plovers are federally endangered and tier I species of Greatest Conservation Need that use the Yellowstone River corridor. A thorough survey and inventory of the study area during the nesting seasons of these species by will provide wildlife managers with accurate distribution, nest occupancy, and productivity data.

Therefore, to address the aforementioned information gaps the objectives of this study are to:

1.) Describe seasonal movement patterns and habitat use of adult blue sucker, burbot, channel catfish, and shovelnose sturgeon.
2.) Identify and describe potential blue sucker spawning habitats.
3.) Identify potential burbot, channel catfish, and shovelnose sturgeon spawning aggregations
4.) Describe distribution, movements, and habitat use of spiny softshell turtles
5.) Determine distribution and nesting success of interior least terns, piping plovers, and bald eagles

<u>Expected Results and Benefits</u>

<u>Objective 1:</u> Description of seasonal movement patterns and habitat use of blue sucker, burbot, channel catfish, and shovelnose sturgeon in the Yellowstone River will elucidate the seasonal suitability of segments of this drainage as well as the effect of diversion dams. Description of seasonal movements and habitat use for these species will also

address the identified need of development of the most effective and efficient standardized sampling protocols to better monitor population trends (e.g. Jones-Wuellner and Guy 2004). Cumulatively, the information from this study will contribute to the limited knowledge base we have of these species and result in more effective ecosystem based management and conservation efforts.

<u>Objective 2:</u> Description of blue sucker spawning habitats will begin to address the primary information gap and research objective for this species in Montana (Gardner 1998) and provide insight into factors limiting this population.

<u>Objective 3:</u> Identification of burbot, channel catfish, and shovelnose sturgeon aggregation sites will provide a better understanding of their ecology and susceptibility to overharvest. Information related to seasonal aggregation may also provide insight into preferred spawning habitats of these species. Investigation of burbot spawning habitats in the Yellowstone River also satisfies one of the primary research needs identified for this species in Montana (Jones-Wuellner and Guy 2004).

<u>Objective 4:</u> Description of distribution, movements, and habitat use of spiny softshell turtles will provide managers insight into the life history requirements of this species, thereby enabling more informed river management recommendations.

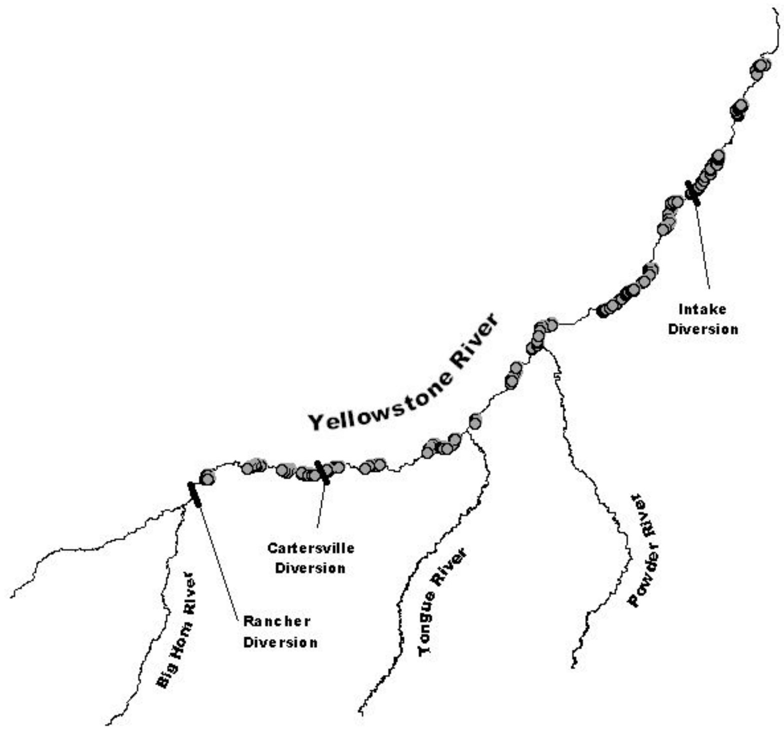
<u>Objective 5:</u> Information about nesting location and success of bald eagles, least terns, and piping plovers will provide managers with additional information regarding annual productivity and contribution towards recovery goals of these threatened birds.

Approach

Fifty channel catfish, five burbot, and forty blue sucker and shovelnose sturgeon were collected by electrofishing, drifting trammel nets, or setting baited hoop nets beginning in April 2005 between the confluence with the Big Horn River (river km 473) and the confluence with the Missouri River (river km 0; Figure 2). This section of river was divided into the following six reaches predicated on geomorphic differences and the presence of potential migratory barriers: 1) Big Horn River to Rancher Diversion, 2) Rancher Diversion to Cartersville Diversion, 3) Cartersville Diversion to Miles City, 4) Miles City to Fallon, 5) Fallon to Intake Diversion, 6) Intake Diversion to the Confluence with the Missouri River. Ten fish of each species were or will be collected from each reach. Within each reach, sampling points were randomly selected and sampled in the order of their selection. Gears were deployed as appropriate within no more than five kilometers of the selected sampling point and a maximum of three fish were telemetered at any given sampling point. Only adult fish were used as determined by established species-specific lengths at sexual maturity or the expression of gametes. Radio transmitters of two sizes were used to maximize battery life while avoiding transmitter-to-body-weight ratios in excess of 2% (Winter 1996). Burbot received transmitters that were 46 mm long and 16 mm in diameter, weighed 16 g, and had a minimum battery life of 761 days. Blue sucker, channel catfish, and shovelnose sturgeon received transmitters that were 73 mm long and 16 mm in diameter, weighed 26 g, and had a minimum battery life of 1686 days. Transmitters were implanted immediately following capture using procedures modified from Hart and Summerfelt (1975). Incisions were closed using size 35W stainless steel surgical staples (Pegg et al. 1997). Transmitter antennae trailed externally (Ross and Kleiner 1982). Transmitters were labeled with a return address and phone number to facilitate return by the public if fish were harvested or found dead. Following surgery, fish were placed briefly (< 15 minutes) in a holding tank until they recovered from anesthesia and then released near the point of capture.

Forty spiny soft-shell turtles were collected using baited hoop nets. Turtles were collected using a stratified random sampling design similar to that used for fish collection except that fewer turtles will be collected from each reach. Transmitters were attached externally through holes made at the base of the carapace using stainless steel surgical wire. Additional spiny softshell turtles will be telemetered at upstream locations in subsequent years.

Figure 2. Locations sampled during 2005. Shaded circles indicate location where at least one radio transmitter was implanted into a target species.



Fish and turtles were relocated by boat twice per month from September through November. During December, when the river was ice-covered, relocations were made once by aircraft. The entire study area was traversed during each relocation period. Permanent receiving stations were placed at the Powder, Tongue, and Big Horn rivers, and Intake and Cartersville diversions to assess tributary use, entrainment, and movement beyond the study area. Locations of fish and turtles that moved downstream into the Missouri River were obtained by Montana Fish, Wildlife and Parks Region 6 permanent receiving stations. Following detection, coordinates of the location were determined using a hand-held global positioning unit (Winter 1996). Location was converted to river kilometer using geographic information system (GIS) software.

Preliminary findings

Although formal data analysis will not occur until the project is completed, patterns were evident during the first season of fish and turtle collection and relocation. No blue sucker or shovelnose sturgeon were collected upstream of Cartersville diversion, which is consistent with findings of previous sampling efforts (Stewart 1998). Burbot C/*f* was negatively correlated with water temperature; few burbot were captured at water temperatures greater than 15 ^{o}C (Figure 3). This was likely related to the negative correlation between length of daily activity period and water temperature that has been observed in burbot (Paakkonen et al. 2000). Turtle C/*f* was positively correlated with river kilometer and no turtles were captured downstream of Sidney, MT (rkm 50; Figure 4). Absence of turtles downstream of Sidney may be related to the shift in dominant substrate from gravel and cobble to fines and sand that occurs there (Bramblett and White 2001). Most telemetered blue suckers moved out of the Yellowstone River by late autumn. This movement pattern was consistent with that of blue suckers telemetered in the Missouri River (Braaten and Fuller 2004).

Figure 3. Burbot C/f versus water temperature, 2005.

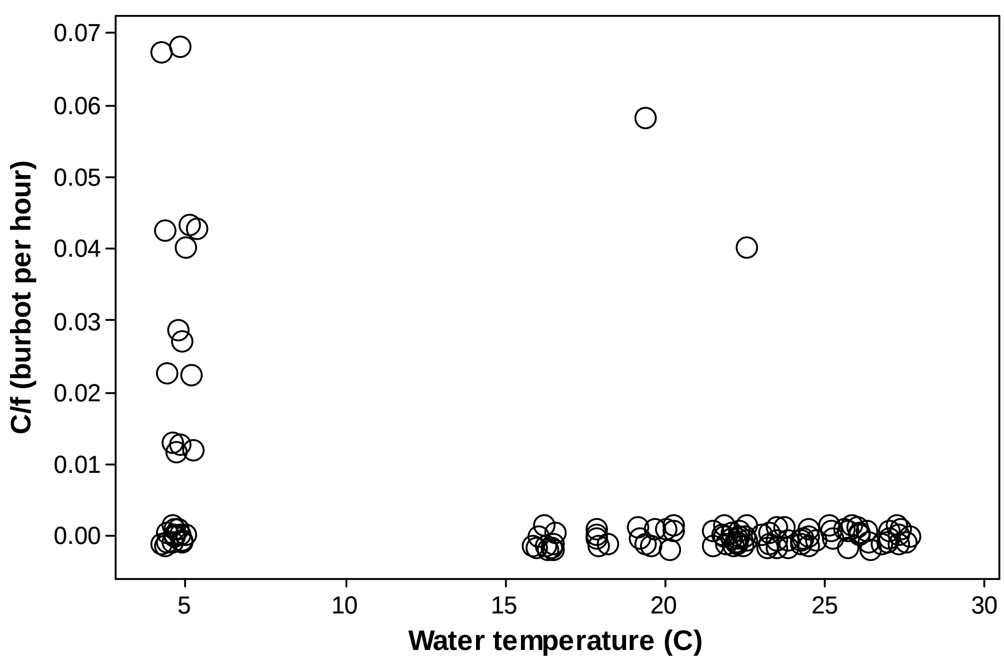
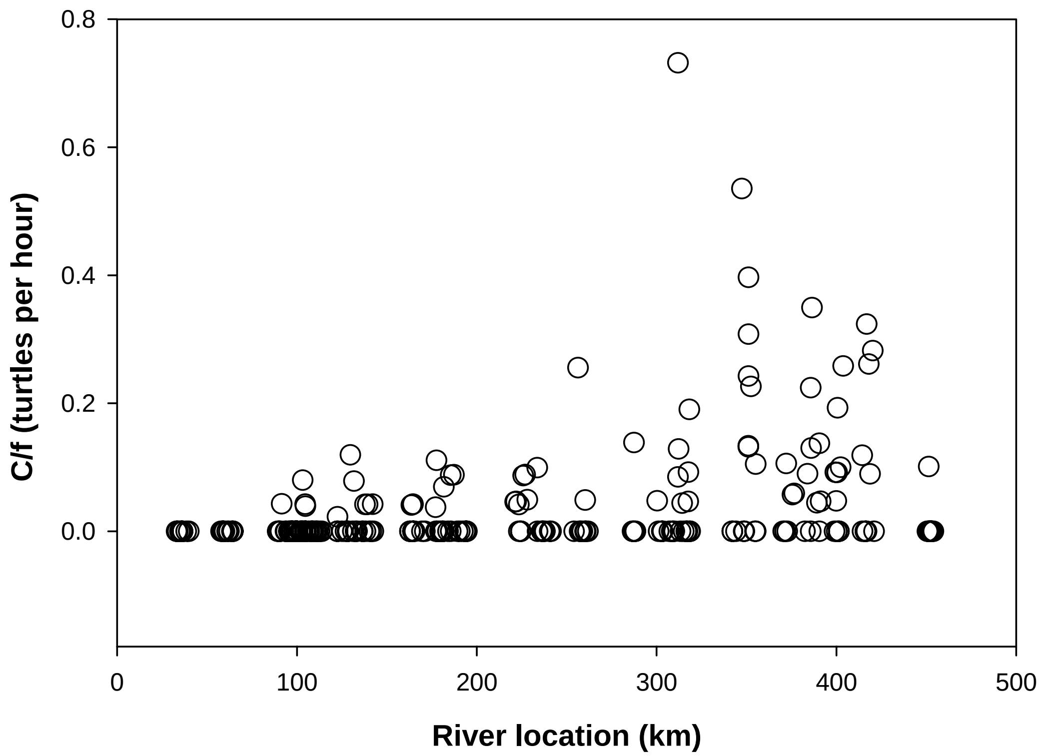


Figure 4. Turtle C/f versus river location, 2005.



Future work

Remaining transmitters (45) will be implanted in burbot. Sampling efforts will commence immediately following ice-off and continue until water temperatures increase to above 15°C. If all transmitters are not implanted during spring 2006 then burbot sampling will begin again once water temperatures decrease below 15°C during autumn 2006.

Fish and turtles will be relocated by boat once per week from April through July and twice per month from August through October. During December through March, when the river is ice-covered, relocations will be made every three weeks by aircraft. The entire study area will be traversed during each one-week relocation period. Permanent receiving stations placed at the Powder, Tongue, and Big Horn rivers, and Intake and Cartersville diversions to assess tributary use, entrainment, and movement beyond the study area. Locations of fish and turtles that move downstream into the Missouri River will be obtained by Montana Fish, Wildlife and Parks Region 6 sampling crews. Following detection, coordinates of the location will be determined using a hand-held global positioning unit (Winter 1996). Location will be converted to river kilometer using geographic information system (GIS) software.

Annual patterns of movement between spawning and home locations will be described by plotting relocation histories of telemetered fish. Total and net movement rates (km/d) during each month will be calculated for telemetered fish and turtles. Total movement rate will be calculated by dividing the distance in river kilometers between successive relocations of a given fish or turtle by the number of days that have elapsed between relocations (White and Garrott 1990). Net movement rate will be calculated by dividing the change in river kilometer between successive relocations by the number of days that have elapsed between relocations such that a positive rate indicates upstream movement and a negative rate indicates downstream movement (Bramblett 1996). Because additional movement may occur between relocations, calculated movement rates will represent the minimum movement for the time period between relocations. Median monthly movement rates will be compared using a Kruskal-Wallis test (Zar 1999). When significant differences are detected, Dunn's multiple comparisons test will be used to determine which monthly rates differ (Zar 1999).

Habitat Use

Seasonal habitat selection will be examined at two hierarchically nested spatial scales: reaches classified based on underlying geologic type and pool/riffle-scale habitat types (Frissell et al. 1986). Geologic types will be delineated using geologic maps (Montana Bureau of Mines and Geology 1979-2001b) and GIS software. They will be required to exist continuously for a minimum of 20 channel widths (about 4 km) to be considered a separate reach (Frissell et al. 1986; Leopold et al. 1992).

Habitat types will be delineated using low-level 1:24,000 scale color infrared aerial photographs and physical features inventory (Natural Resources Conservation Service

2002), geologic maps (Montana Bureau of Mines and Geology 1979-2001b), and GIS software. Habitat type classification will be predicated on geomorphic function (i.e. pool, crossover, side channel) and bank material (i.e. bedrock, alluvium, rip-rap). Differences in depth, substrate, and velocity among habitat types will be quantified using measurements collected from randomly selected habitat types stratified by geologic reach from July through October each year.

Total linear availability of each geologic and habitat type during base flow and runoff periods will be quantified using GIS software. Availability at base flow will be calculated by considering the amount of habitat provided by all habitat types except seasonally inundated side channels. Availability during runoff will include seasonally inundated side channels.

Seasonal habitat use by fish at both spatial scales will be determined using all telemetry relocations. Seasons will be based empirically on life history characteristics and movement rates. Habitat use by individual fish will be calculated for each season as the proportion of relocations that were made within each geologic type, habitat type, and habitat type stratified by geologic type (Manly et al. 2002). Use at both scales will be determined using GPS coordinates of each relocation, field notes, color infrared aerial photographs and physical features inventory (Natural Resources Conservation Service 2002), geologic maps (Montana Bureau of Mines and Geology 1979-2001b), and GIS software.

Chi-square tests with log-likelihood test statistics (Manly et al. 2002) will be used to test the null hypothesis of seasonal selection in proportion to availability for different geologic types, habitat types, or habitat types stratified by geologic type. Selection ratios and simultaneous 95% Bonferroni confidence intervals (Manly et al. 2002) will be used to determine level of selection for specific resource categories. Selection ratios for the population will be obtained by averaging selection ratios calculated for individual telemetered fish (Manly et al. 2002).

Physical characteristics of each geologic reach and habitat type will be determined using a stratified random sampling design. Within each geologic reach, habitat units of each habitat type will be randomly selected for physical characterization. Within each selected habitat unit, velocity, depth, and substrate will be measured at 100 randomly selected points. This sampling design will result in characterization of and allow comparison among geologic reaches, habitat types, or habitat types stratified by geologic reach.

Spawning habitats of blue sucker will be additionally described by depths, substrates, turbidities, distance from tributaries, and other biologically relevant characteristics of specific habitat units where spawning occurs. Spawning will be determined by the presence of blue sucker eggs or larvae and aggregations of ripe and spent adults.

Aggregation

Spatial distribution among individuals will be examined for each week of telemetry relocations using a one-dimensional adaptation of neighbor K statistics (O'Driscoll 1998). Statistical significance of spatial pattern will be determined by including 90% confidence intervals of L(t) obtained from 999 randomizations, which represent the significance level of $P = 0.10$.

Bald Eagles

Cottonwood tree galleries along the riparian corridor will be visually scanned for bald eagle nests during nesting season. GPS coordinates of all bald eagle nest locations will be recorded. Follow-up surveys of those nests will occur in mid-July to determine nest success and fledging rate.

Least Terns and Piping Plovers

Appropriate sandbar and shoreline habitat will be searched for federally threatened least terns and piping plovers during nesting periods. GPS coordinates of tern and plover locations will be recorded, along with nesting and productivity observations.

Region 5

Region 5 crews will begin sampling efforts upstream of the Big Horn River. Burbot, channel catfish, and spiny softshell turtles will be telemetered and fish relocated between the Big Horn River and Clarks Fork following the methods described above. Habitats will be characterized and bald eagle and least tern surveys will also occur as part of this effort.

Literature Cited

Braaten, P. J. and D. B. Fuller. 2004. Fort Peck flow modification biological data collection plan, summary of 2003 activities. Received by U.S. Army Corps of Engineers, Fort Peck.

Bramblett, R. G. 1996. Habitats and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri Rivers, Montana and North Dakota. Ph.D. dissertation, Montana State University, Bozeman.

Bramblett, R. G., and R. G. White. 2001. Habitat use and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri Rivers in Montana and North Dakota. Transactions of the American Fisheries Society 130: 1006-1025.

Carlson, J. 2003. Montana animal species of special concern. Montana Natural Heritage Program and Montana Fish, Wildlife and Parks Report, Helena.

Frissell, C. A., W. J. Liss, C. E. Warren, and M. D. Hurley. 1986. A hierarchical framework for stream habitat classification: viewing streams in a watershed context. Environmental Management 10:199-214.

Gardner, W. M. 1998. Blue Sucker. Montana Chapter of the American Fisheries Society. Available: http://www.fisheries.org/AFSmontana/SSCpages/Bluesuckstatus.htm (October 2004).

Jones-Wuellner, M. R. and C. S. Guy. 2004. Status of burbot in Montana. Report of Montana Cooperative Fishery Research Unit. Received by Montana Fish, Wildlife and Parks, Helena.

Leopold, L. B., M. G. Wolman, and J. P. Miller. 1992. Fluvial processes in geomorphology. Dover Publications, Mineola.

Manly, B. F. J., L. L. McDonald, D. L. Thomas, T. L. McDonald, and W. P. Erickson. 2002. Resource selection by animals. Kluwer Academic Press, Dordrecht.

Montana Bureau of Mines and Geology. 1979. Geologic map of the Hysham 30’ x 60’ quadrangle, Montana. 1:100,000. Open-file report no. 371. Butte.

Montana Bureau of Mines and Geology. 1980. Geologic map of the Terry 30’ x 60’ quadrangle, Montana. 1:100,000. Open-file report no. 284. Butte.

Montana Bureau of Mines and Geology. 1981a. Geologic map of the Sidney 30’ x 60’ quadrangle, Montana. 1:100,000. Open-file report no. 277. Butte.

Montana Bureau of Mines and Geology. 1981b. Geologic map of the Wibaux 30’ x 60’ quadrangle, Montana. 1:100,000. Open-file report no. 282. Butte.

Montana Bureau of Mines and Geology. 1998. Geologic map of the Glendive 30’ x 60’ quadrangle, Montana. 1:100,000. Open-file report no. 371. Butte.

Montana Bureau of Mines and Geology. 2000. Geologic map of the Billings 30’ x 60’ quadrangle, Montana. 1:100,000. Geologic map series no. 59. Butte.

Montana Bureau of Mines and Geology. 2001a. Geologic map of the Miles City 30’ x 60’ quadrangle, Montana. 1:100,000. Open-file report no. 426. Butte.

Montana Bureau of Mines and Geology. 2001b. Geologic map of the Forsyth 30’ x 60’ quadrangle, Montana. 1:100,000. Open-file report no. 425. Butte.

Montana Fish, Wildlife and Parks. 1997. Montana warmwater fisheries management plan, 1997-2006. Montana Fish, Wildlife and Parks, Helena.

Natural Resources and Conservation Service. 2002. Lower Yellowstone River Corridor Color Infrared Digital Orthophotography, Montana. Natural Resources and Conservation Service, Bozeman. Available: www.nris.state.mt.us/yellowstone/LowerYel/LowerYelPhotos.html (April 2004).

O’Driscoll, R. L. 1998. Description of spatial pattern in seabird distributions along line transects using neighbor K statistics. Marine Ecology Progress Series 165:81-94.

Paakkonen, J. P., M. Laitinen, T. J. Marjomaki. 2000. Total activity in burbot measured with a bioelectric monitoring system: seasonal differences in activity length. Pages 38-47 in V. L. Parmagamian and D. W. Willis, editors. Burbot: biology, ecology, and management. American Fisheries Society, Fisheries Management Section, Publication number 1, Bethesda.

Pegg, M. A., P. W. Bettoli, and J. B. Layzer. 1997. Movement of saugers in the lower Tennessee River determined by radio telemetry, and implications for management. North American Journal of Fisheries Management 17:763-768

Ross, M. J., and C. F. Kleiner. 1982. Shielded-needle technique for surgically implanting radio-frequency transmitters in fish. Progressive Fish-Culturist 44:41-43.

Stewart, P. A. 1998. Southeastern Montana fisheries investigations. Montana Fish, Wildlife and Parks Report F-78-R-4, Helena.

White, R. G., and R. G. Bramblett. 1993. The Yellowstone River: its fish and fisheries. Pages 396-414 in L. W. Hesse, C. B. Stalnaker, N. G. Benson, J. R. Zuboy, editors. Restoration planning for the rivers of the Mississippi River ecosystem. Biological Report 19, National Biological Survey, Washington, D.C.

White, G. C., and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego.

Winter, J. D. 1996. Advances in underwater biotelemetry. Pages 555-590 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques. American Fisheries Society, Bethesda.

Zar, J. H. 1999. Biostatistical Analysis. Prentice Hall, Upper Saddle River.